

"This baby became as bad as the first one." The typical symptoms were present, practically no food being retained. On March 27th a posterior gastroenterostomy was done. He was fed after the anesthesia wore off. He vomited bile at times for the first few days, but gradually made a perfect recovery. The patient is to-day perfectly normal. Two months ago Dr. H. E. Ruggles made X-ray examinations of these children, and reported bismuth passing through the artificial opening in both cases.

At this time I should like to report three patients operated upon after the method of cutting the tumor to the submucosa and dropping it back, with no further interference.

The first child, A. F., a male, eight months old, was brought to the hospital on July 12th, 1915, and operated upon July 14th. As has been observed in some of our other cases who had drifted along so many months, the patient stood the operation badly, and died five hours after being returned from the operating room, from edema of the lungs. Quantities of fluid poured from the lungs before death. The pulse was fair after breathing stopped. I was able to immediately open the abdomen, and found that the incision through the tumor was even full of a blood clot, and the film-like omentum had wrapped itself over the wound about the pylorus even at this early period, so that it was detached with difficulty. There was no blood in the abdomen. The stomach was markedly contracted and empty, and the pylorus freely patent.

The second case, P. R., male six weeks old, was operated upon August 13, 1915. A typical tumor was found, which was incised to the submucosa, nothing further being done. The child was fed after the anesthesia wore off, and there was no vomiting. The patient improved immediately, and is to-day normal in every way.

The third patient, H. B., male, aged six weeks, was operated upon May 18, 1916. Split tumor to submucosa. The child was fed after the anesthesia wore off, and did not vomit after the operation. He is to-day in good health.

There is enough evidence on which to make the following conclusions:

- (1) Congenital pyloric stenosis must be diagnosed early.
- (2) It must be relieved by operation.
- (3) The operation known as Rammstedt's is by far the best, as it is the simplest, quickest and safest.
- (4) A pediatrician should work with the surgeon, in order that the baby may be properly watched and fed.
- (5) Babies said to have recovered from this condition medically were improperly diagnosed, as the tumor could not have been present.
- (6) The anesthetist should be the best possible.

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## PRELIMINARY TESTS OF THE BLOOD IN TRANSFUSIONS.\*

By S. H. HURWITZ, M. D., San Francisco.

I wish to speak to you concerning those accidents in transfusion which may result from the incompatibility of the donor's and recipient's blood. Due to the increasing popularity of transfusion and its greater application as a therapeutic measure, it is becoming more and more necessary to exclude wherever possible agglutinative and hemolytic donors by careful preliminary tests. Two bloods are incompatible if the one contains agglutinins or hemolysins for the red corpuscles of the other. Strictly speaking, the occurrence of agglutinins in human blood is not a pathological phenomenon, for it has been shown by a number of workers that all normal human bloods contain agglutinins in greater or less concentration. In fact, on this basis it has been possible to classify individuals into four permanent and hereditary groups according as to whether the serum of one agglutinates the red corpuscles of the other; only those individuals belonging to the same group, whose bloods do not agglutinate one another. Furthermore, it has been shown with some degree of certainty that intravascular agglutination may give rise to no serious clinical symptoms. There is no evidence that agglutinative transfusions will cause embolism or thrombosis.

The occurrence of intravascular hemolysis, however, is a pathologic phenomenon, and may give rise to serious clinical symptoms, often leading to death. These symptoms are doubtless familiar to most of you. Following a severe constitutional reaction attended with chills and fevers, there results a hemoglobinemia with an extreme reduction of hemoglobin followed by hemoglobinuria of shorter or longer duration and by certain cutaneous manifestations of an urticarial or purpuric character.

From a practical viewpoint, it is important to know in the first place with what frequency one may expect to observe agglutinative and hemolytic phenomena in transfusion; and in the second place, it is important to know whether there is any intimate relationship between hemolysis in the test tube and intravascular hemolysis. Unfortunately, the first point cannot be answered with extreme certainty, for, as you know, clinicians have been more concerned with the perfection of the technic of transfusion rather than with the study of the blood preliminary to transfusion; and consequently, no accurate statistics on this point

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are available. From the work of a few observers, who have carried out routine preliminary tests upon a large number of donors and patients, it is possible to state that one may encounter incompatible blood in about ten per cent. of the cases. Concerning the second point, more definite information is available for we now know from clinical and experimental evidence, that there is a very close relationship between hemolysis in the test tube and hemolysis in the body of the patient, so that it is possible to approach a transfusion without anxiety if *in vitro* tests for agglutination and hemolysis have been demonstrated to be absent.

Now a few words concerning the tests which have been used within recent years to demonstrate the presence of agglutination or hemolysis in the bloods of patient and donor. The classical procedure is doubtless familiar to all of you, and especially to those who have carried out any serological technic or have done the routine Wassermann reaction. It is necessary merely to aspirate some blood from donor and patient and to divide each specimen into two parts. One of these is permitted to clot for the expression of serum, and the other is delivered into some anti-coagulating fluid, either citrate or oxalate. From the latter specimen, the red corpuscles are obtained by centrifugalization.

These are now washed in salt solution, and made up to a definite suspension varying from one to five per cent. It is now simply necessary to mix definite amounts of the corpuscle suspension with varying dilutions of the patient's serum and to incubate these mixtures at body temperature. Hemolysis can be easily noted macroscopically by a reddish coloration of the supernatant fluid after a sedimentation of the red cells. Agglutination may also be noted directly by a clumping of the red corpuscles at the bottom of the test tube. For purposes of completeness, furthermore, it is essential to test in this manner not only the corpuscles of the donor against the serum of the patient, but also the red cells of the patient against the serum of the donor. Some short cuts of this technic have been introduced by various workers. Ottenberg and Epstein, for instance, mixed the bloods of donor and recipient in Wright's capillary pipettes instead of in the usual test tube; but in other respects their method does not differ from the usual procedure.

A method which promises much from the point of view of simplicity and accessibility to the average worker is used by Weil of New York. This worker, instead of separating the blood into corpuscles and serum, uses the mixtures of citrated bloods. The whole citrated bloods of both donor and patient are mixed in three different dilutions. One tube contains a mixture of 0.5 cc. of the donor's citrated blood and 0.5 cc. of the citrated blood of the patient. In the second tube the mixtures are present in the proportion of nine to one, and in the third tube in the proportion of one to nine. After a period of incubation, it is possible to tell macroscopically whether or not hemolysis is present in the blood, either of donor or recipient or both. It is not possible as yet to state

with any certainty just how accurate this procedure is and whether the presence of the citrate may or may not mask the presence of hemolysins in weak concentration.

Working on a similar principle, Rous and Turner have recently introduced a still more simplified method of testing donors for transfusion. They employ the ordinary white cell pipette used for the enumeration of the leukocytes. A 10% citrate solution is drawn up to the 1 mark and blood obtained from a prick of the finger or the lobe of the ear is drawn up to the 11 mark. The mixture is now rapidly expelled into a test tube, and this procedure is repeated until sufficient citrated blood is obtained both from donor and recipient for the test. The citrated bloods are now mixed in Wright's capillary pipettes in the proportion of one to one, one to nine, and nine to one. The ends of the pipettes are sealed, and after a period of standing at room temperature varying from five to fifteen minutes, readings for agglutination are made microscopically. A drop of the mixture is expelled upon a slide to which is added a drop of salt solution for purposes of procuring a more homogenous suspension. A study of the film under the microscope will show in the presence of agglutinating mixtures the presence of smaller or larger clumps instead of the usual dispersion of the red cells or their formation into rouleaux. The value of testing for agglutination depends upon the well-known fact that this phenomenon may occur at times without hemolysis, but that hemolysis is usually associated with or precedes agglutination, so that by excluding the latter phenomenon, it is possible to exclude also the former.

It is possible, therefore, to state with a fair degree of certainty that accidents in transfusion due to the occurrence of hemolysis and agglutination between the bloods of donor and recipient may be excluded by careful preliminary tests, and that there is a close relationship between test tube hemolysis and intravascular hemolysis. The value of using citrated blood in carrying out the preliminary tests instead of following the classical procedure still remains to be determined by testing the bloods of a large number of donors and recipients.

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